national accelerator laboratory

EXP-37
March 27, 1973

ACCELERATOR EXPERIMENT--"The" Loss Monitor Calibration

Experimentalists: E. J. Bleser

Date Performed: 8 March 1973

The loss monitors developed by Fred Hornstra provide a method of measuring the extraction efficiency to high precision. In the Transfer Hall there is a 400' gas-filled cable strung in the cable tray above the magnets which is called "The" Loss Monitor (TLM). The amount of ionization in this cable during extraction is measured and is available in the Control Room in digital form. This value is assumed to be proportional to the losses in the Transfer Hall and thus to the extraction inefficiency. The extraction efficiency is normally measured by taking the ratio of the SEM at the end of the Transfer Hall to the Main Ring Intensity Monitor (MRI). These numbers are known absolutely to perhaps 5 or 10%, and we thus measure extraction efficiency to be of the order of 85 $\pm$10%. By calibrating TLM to 10%, we can measure the inefficiency to be 15% $\pm$1.5% and the efficiency to be 85% $\pm$1.5%.

By detuning various extraction devices, it is possible to leave most of the beam in the machine, presumably to be lost in the Transfer Hall. Figure 1 shows a plot of TLM versus the extraction efficiency. The straight line is a reasonable fit and has been made to intercept the Y axis at TLM/MRI = 20 for convenience. Further work can give better results, but for the present we have

$$\frac{\mathrm{TLM}}{\mathrm{MRI}} = 1 \rightarrow 5\% \pm 0.5\% \text{ extraction losses.}$$

In general, we have $\frac{\mathrm{TLM}}{\mathrm{MRI}} = 3$, or 85% extraction efficiency. We have observed for periods as long as days: $\frac{\mathrm{TLM}}{\mathrm{MRI}} = 1.7$, or

92% efficiency. For reasons not yet understood, this is hard to maintain.

Since 1 count in MRI represents 10^9 protons, one count in TLM represents 5×10^7 protons lost in the Transfer Hall. In Figure 2, the data is replotted as a scatter plot showing the protons lost in the Transfer Hall according to TLM versus those lost as calculated by subtracting the external proton beam intensity from the main ring intensity.

Figure 3 is a plot of TLM, the loss monitor at the downstream end of the extraction Lambertson (XLAM DWNS) and the extraction SEM (XSEM), all normalized to the main ring intensity (MRI). The horizontal axis shows first the increase of the extraction electrostatic septum (XES) voltage from 30 to 50 kV, with the POS bump current set to 0, and then, with XES set to 65 kV, the increase of the POS bump current from 0 to 46 amps. There is not particular significance to this form of plotting other than convenience.

Two observations made on Figure 3 are:

1. As POS increases, XSEM drops more rapidly than TLM increases. These points correspond to those in Figures 1 and 2 which fall well below the curve and probably represent beam being lost well down the extraction channel where TLM is not especially sensitive. Tuning the extraction channel as POS is increased might keep XSEM at a higher level.
2. The rapid rise of XLAM as POS increases probably indicates that we have such a large position bump that it is hitting the Lambertsons. Data not plotted for the losses on the upstream end of the Lambertsons and the electrostatic septa do not show such a rapid rise.

EJB:cb

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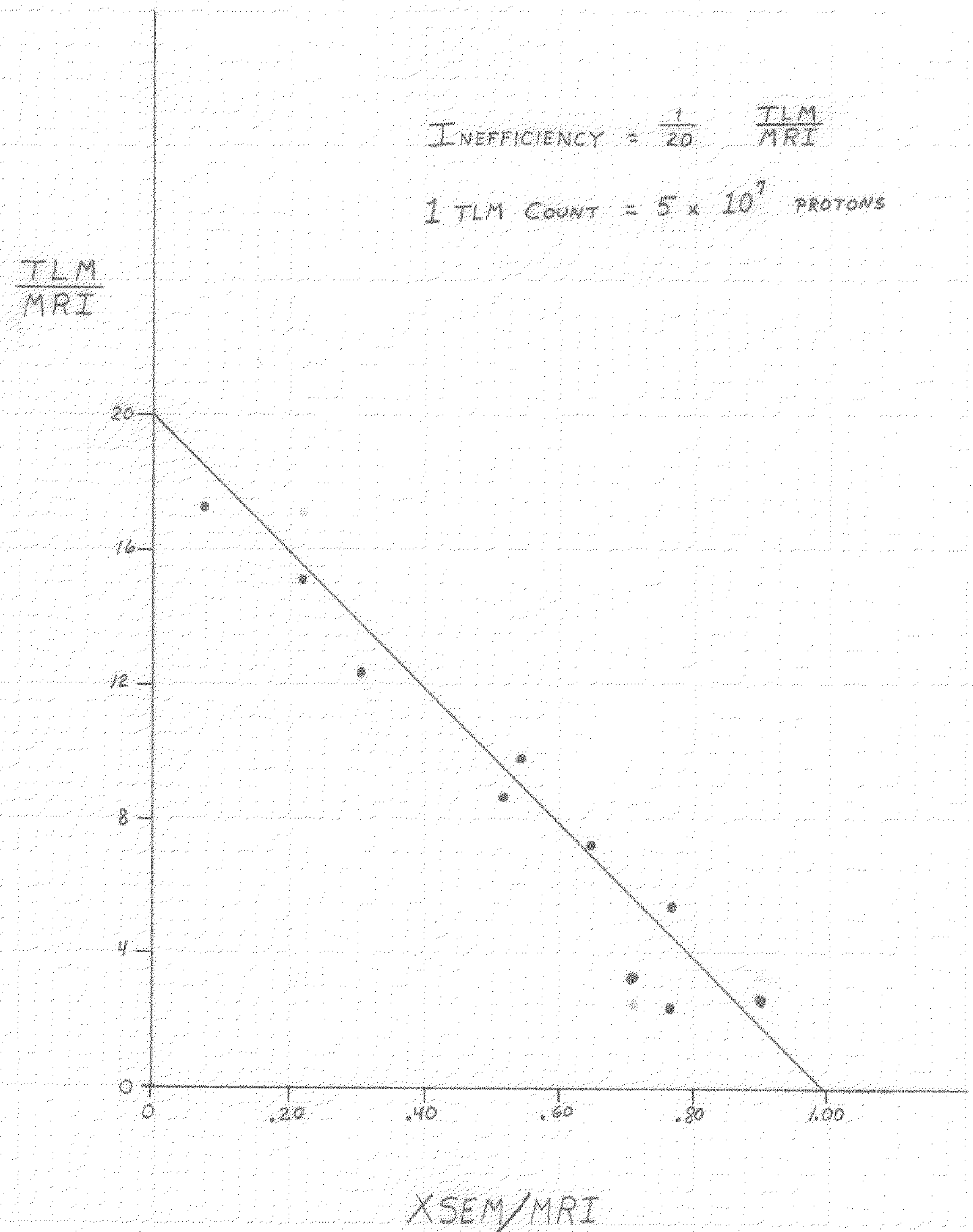
SECTION	PROJECT	SERIAL-CATEGORY	PAGE
			Fig. 1

SUBJECT: Calibration of "The" Loss Monitor

NAME: E. J. B.

DATE: 3/8/73

REVISION DATE:



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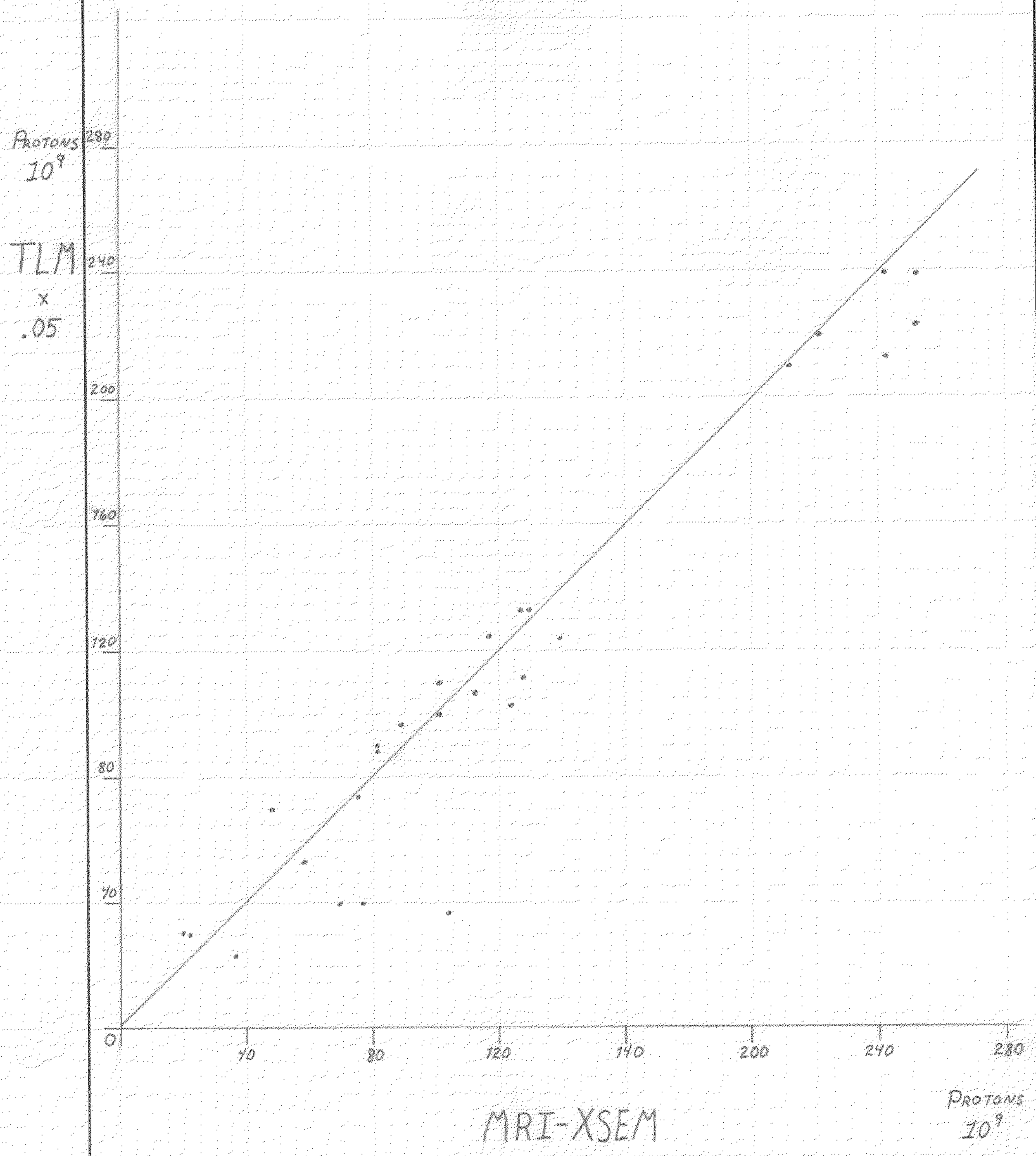
SECTION	PROJECT	SERIAL-CATEGORY	PAGE
			Fig. 2

SUBJECT: "The" Loss Monitor vs. Intensity Monitor Differences

NAME: E. J. B.

DATE: 3/8/73

REVISION DATE:



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SECTION	PROJECT	SERIAL-CATEGORY	PAGE
			Fig. 3

SUBJECT	NAME
Loss Monitors vs. Pos Bump & E.S. Voltage	E. J. B.
	DATE 3/8/73	REVISION DATE